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(54) TRAINING APPARATUS FOR DRIVERS

(71) We, AUTOMOBILNI OPRAVARSKY ZAVOD, a Czechoslovak body corporate of Olomouc, Czechoslovakia, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The invention relates to a training apparatus for the instruction of vehicle drivers, more especially of motor vehicle drivers, which comprises an electronic system for the simulation of the action of the various parts of the vehicle, wherein the engine simulator consists of an electric circuit and the gearbox simulator consists of another electric circuit, in which resistors and at least one capacitor are connected for the simulation of the inertia of the vehicle mass.

Training apparatus for the instruction of motor vehicle drivers, more especially motor-car drivers, are a modern means of teaching, which are being employed to a constantly increasing extent. The most advantageous type is a training apparatus in which the pupil directly actuates the projection of a visual image, generally a shadow image. In known constructions of this type of training apparatus, there is provided an electric motor which drives through the conventional automobile vehicle clutch the gearbox of the vehicle, to the output of which there is connected a resilient shaft which drives the mechanism for the shadow projection. The disadvantage of this type of training apparatus resides in that it is relatively costly to operate and to construct, because the clutch and the electric motor have relatively costly components. Another disadvantage of such a training apparatus is the relatviely high electric power requirement for driving the electric motor. This disadvantage is reflected in the cost of the driving instruction and the excessive weight of the whole apparatus.

The new training apparatus therefore comprise, instead of a true gearbox, a coupling and an engine, an electric circuit in which the individual speed stages of the gears are simulated by resistors of different values, while the engine is simulated substantially by an electric circuit which is connected to the source of the electric current, which is generally a low-voltage current, and the clutch is simulated by a switch or a variable resistor. The electric circuit for the simulation of the engine and of the gearbox is mechanically connected to another circuit for the simulation of the noise of the engine as in hitherto known apparatus (for example U.S.A. Patent No. 3,154,864). There is then connected to the output of the simulation circuit of the gearbox a device for simulating the movement of the vehicle, generally a voltmeter calibrated as a speedometer tachometer, or the like. While this construction of the training apparatus has particular advantages over the training apparatus described in the foregoing, it has a number of disadvantages which result in an incomplete simulation of the individual components of the vehicle. Thus, for example, in the hitherto known training apparatus the circuit for simulating the engine and the gearbox is provided with a variable resistor which is mechanically coupled to the circuit for simulating the engine noise with the associated amplifier. Such an arrangement is disadvantageous because during practical instruction it simulates the noise of the engine or the increasing revolutions thereof without regard to the gear stage which has been engaged, that is to say, without regard to which one of the resistors simulating the engaged gear stage is in circuit. Another disadvantage of the hitherto known training apparatus resides in that they render possible a substantially arbitrary shifting of the gears, especially during a simulated journey, when in practice such gear changing is not possible in an automobile vehicle. The hitherto known training apparatus have no device for simulating the noise of a travelling vehicle, for example rattling of the body, tyre sounds and the like that is to say, of the characteristic subsidiary sounds set up during the running of an automobile vehicle, for example a motor-car.

[Price 25p]

Another development of trainers of this type consists in the replacement of the mechanical connection by an electrical one. In consequence to this measure, the simulation of the engine sound is not only coupled with the position of the accelerator pedal but also with the simulated driving speed.

The aforesaid disadvantages and a number of other disadvantage of the hitherto known training apparatus may be obviated in the training apparatus according to our invention which aims at improving the trainers in such a way as to render the simulation of the car starting procedure at the thrown in velocity stage as far as possible similar to that of the actual vehicle.

The invention provides training apparatus for instructing vehicle drivers, provided with an electric system for simulating the action of various component parts of the vehicle, comprising a first electric circuit for the simulation of the engine and a second electric circuit for the simulation of the gear box, the second circuit including resistors and at least one capacitor for the simulation of the inertia of the vehicle, an output of the second circuit being connected to the input of a third circuit for controlling a vehicle movement indicator, an acoustic transducer for the simulation of the engine noise being connected to an output of the first electric circuit, and the second circuit including selectable voltage limiters connected in parallel, one input of the second circuit including selectable charging branches and its output to a first trigger circuit including selectable feed branches connected in parallel.

The training apparatus according to the invention is preferably provided with a voltage divider, for example with a resistor, which is connected to the circuit for the simulation of a gearbox at the point of connection of the circuit for the simulation of the engine. This variable voltage divider simulates the action of the accelerator of the automobile vehicle. Another preferred feature of the training apparatus according to the invention is a construction in which there are connected in parallel with the electric circuit for the simulation of the gearbox an input and an output of a trigger circuit for discharging the capacitor which simulates the inertia of the vehicle, while the input of the said trigger circuit is provided with a system of stepped resistors, each of which is provided with a switch which is connected to the control lever of the training apparatus. Connected in parallel with the electric circuit for the simulation of the gear box is another trigger circuit, there being connected in series with the input of the said trigger circuit in the electric circuit for the simulation of the gearbox a resistor which is disposed before the capacitor for the simulation of the inertia of the vehicle. The output of this trigger circuit is connected before the voltage divider, which is disposed at the switching point of the electric circuits for the simulation of the engine and of the gearbox. In the electric circuit for the simulation of the engine, there is connected in known manner at least one capacitor for the simulation of the inertia of the engine. Connected to the output of the electric circuit for the simulation of the gearbox is a device for imitating the noise of the running vehicle, which device is connected to the acoustic transducer through a mixing amplifier, which at the same time is connected between the aforesaid acoustic transducer and the output of the electric circuit for the simulation of the engine.

One embodiment of the engine will now be described, by way of example with reference to the accompanying drawings, in which:

Figure 1 is a block diagram of the training apparatus and

Figure 2 is a simplified diagram of the circuit for the simulation of the gearbox and its connection to the trigger circuits.

The source 1 of the electric low-voltage (for example 24 V) current is connected by a conductor 2 to a trigger circuit 3, which is connected to a variable resistor 5 through a conductor 4. The variable resistor 5 acts as a source of voltage. An output of the variable resistor 5 is connected by a conductor 6 to a circuit 7 for the simulation of the sound of the engine. The circuit 7 includes at least one capacitor (not shown) for the simulation of the inertia of the car engine. The second output of the variable resistor 5 is connected by a conductor 8 to the circuit 9 for the simulation of the gearbox. This circuit 9 is connected to the trigger circuit 3 by means of a conductor 10. At the same time, the circuit 9 is connected by a conductor 11 to another trigger circuit 12, the output of which is applied through a conductor 13 to the circuit 9 for the simulation of the gearbox.

The output of the circuit 9 for the simulation of the gearbox is applied through a conductor 14 to a control circuit 15 for the actuation of the indicator of the vehicle movement. Various devices may be employed as the indicator for the vehicle movement, for example a shadow projection device or a voltmeter calibrated as a speedometer.

It is apparent from Figure 1 that there is connected to the conductor 14 by which the circuit 9 for the simulation of the gearbox is connected to the control circuit 15 a conductor 16 which is connected to a circuit 17 for the simulation of the noise of the running vehicle. The output of the said circuit 17 is connected by a conductor 18 to the input of a mixing amplifier 19, the output of which is connected by a conductor 20 to the input of an acoustic transducer 21. The output of the circuit 7 for the simulation of the engine sound is connected to a second

input of the mixing amplifier 19 by a conductor 22.

The arrangement of the circuit 9 for the simulation of the gearbox will be seen from Figure 2. Connected into this circuit are three branches 23, 24, 25 each of which comprises one switch 26, 27, 28 and one resistor 29, 30, 31. The resistor 29 has the lowest ohmic value, the resistor 30 a medium ohmic value and the resistor 31 the highest ohmic value. The circuit 9 for the simulation of the gearbox includes a variable resistor 32 for the simulation of the clutch. A slider of this resistor is connected to the clutch pedal (not shown) of the training apparatus. In addition, the circuit 9 for the simulation of the gearbox includes, in series, a capacitor 33 and three branches, each of which comprises one Zener diode 34, 35, 36 and one switch 37, 38, 39. The Zener diode 34 in the left-hand branch (Figure 2) has the lowest Zener voltage, the second Zener diode 35 has a medium Zener voltage and the Zener diode 36 in the right-hand branch has the highest Zener voltage.

Connected to the circuit 9 for the simulation of the gearbox is a conductor 11 which merges into three branches 40, 41, 42, each of which is provided with one switch 43, 44, 45 and one resistor 46, 47, 48. The resistors 46, 47, 48 are advantageously adjustable. The ohmic value of the resistor 46 is the highest of the three resistors 46, 47, 48 and the ohmic value of the resistor 48 is the lowest of the said resistors, the resistor 47 having a medium ohmic value. The described branches 40, 41, 42 merge into the conductor 11, which forms the input of the trigger circuit 12. The output of this trigger circuit 12 is connected by the conductor 13 to the circuit 9 for the simulation of the gearbox.

The circuit 9 for the simulation of the gearbox also comprises a resistor 49 which is connected by the conductor 10 to the input of the trigger circuit 3.

As already stated, the slider of the variable resistor 32 is connected to the clutch pedal (not shown). Similarly, the slider of the variable resistor 5 is connected to the accelerator pedal (not shown). The described switches 26—28, 37—39, 43—45 are coupled to the gear lever (not shown) in such manner that when the first gear is engaged the switches 26, 37, 43 are closed, when the second gear is engaged the switches 27, 38, 44 are closed and when the third gear is engaged the switches 28, 39, 45 are closed.

The described training apparatus represents a vehicle having three forward gears, and it operates as follows:

When the source 1 of the electrical energy is connected by a starter (not shown), the electric current flows through the trigger circuit 3 into the variable resistor 5. When the switches 26, 27, 28 are open (Figure 2), the electric current flows through the circuit 7 for the simulation of the engine noise into the mixing amplifier 19 and from there into the acoustic transducer 21. In this situation, the training apparatus only simulates neutral running of the engine.

The engagement of the gear stages takes place as follows: on depression of the clutch pedal, the slider of the variable resistor 32 is brought into the position of highest ohmic value. Engagement of the first gear stage by a gear lever (not shown) closes the switches 26, 37, 43. On simultaneous depression of the accelerator pedal (not shown), which results in a reduction of the ohmic value of the variable resistor 5, and progressive release of the clutch pedal (not shown), i.e. on displacement of the slider of the variable resistor, a continuous charging of the capacitor 33 commences. The value of the charge can reach a level determined by the Zener voltage of the diode 34, which is now operative. The predetermined time delay of the voltage rise, caused by the charging of the capacitor 33, simulates the inertia of the vehicle. The current flows through the conductor 14 into the control circuit 15, to the output of which there is connected a device (not shown) for indicating the movement of the vehicle, for example a shadow projector. At the same time, the current flows through the conductor 16 into the electric circuit 17 for the simulation of the noise of the running vehicle and from there through the mixing amplifier 19 into the acoustic transducer 21. The latter thus reproduces at this instant a mixture of the noise of the engine and of the noise of the running vehicle. The engagement of the other gear stages proceeds similarly.

Of course, the voltage at the output of the circuit 9 for the simulation of the gearbox when the clutch is engaged depends upon the depression of the accelerator pedal, which results in an increase of the charge of the capacitor 33. The upper limit of the charge is determined by the value of the Zener voltage of the diode 34, 35, 36, which is momentarily operative. One of the driver's most important reactions is an instinctive, sensitive release of the clutch pedal on moving off. The training apparatus according to the invention makes it possible to practise this action, because, if the clutch is suddenly released it automatically stops the simulated running of the engine and causes the driver to start again. This effect is achieved in the following way: it will be assumed that the driver releases the clutch pedal too abruptly with the first gear engaged. In this case, the ohmic value of the variable resistor 32 is suddenly lowered, so that voltage is set up across the resistor 49. This unbalanced condition is fed through the conductor 10 into the trigger circuit 3, which interrupts the supply of electrical energy into the whole system. A

similar situation arises in the event of incorrect "moving off" in second or third gear.

Another important aspect of driving instruction is a correct utilisation of the gearbox, more especially in slow travel in a high gear stage, which is harmful to the engine and to the coupling of a normal automobile vehicle. If the driver "drives" too slowly in the third gear, i.e. after closing of the switch 45 of the resistor 48 connected to the input of the trigger circuit 12, the voltage in the circuit 9 for the simulation of the gearbox falls to a value at which an unbalanced condition is set up between the input conductor 11 and the output conductor 13 of the trigger circuit 12, which results in a change-over of the trigger circuit 12 and in the subsequent application of voltage to the resistor 49 in the circuit 9 for the simulation of the gearbox. As in the preceding case, this sets in operation the trigger circuit 3, which cuts off the supply of electrical energy into the whole system.

The technical effect of the training apparatus according to the invention resides above all in the lowering of the cost of manufacture, with a much more perfect simulation of the behaviour of a running vehicle. All the elements employed are simple and readily obtainable and the electronic elements operate very reliably. The imitation of the noise produced by the body of the running vehicle, mixed with the engine noise, produces a more complete illusion on the pupil operating the training apparatus than the hitherto known apparatus. The connection of the circuit for the imitation of the engine noise to the circuit for the simulation of the engine, with the variable resistor J in circuit, which constitutes the soft source of voltage, ensures that the acoustic frequency of the engine increases not only in dependence upon the depression of the accelerator pedal simulator, but also in dependence upon whether the resistor of the associated gear stage is in circuit, which corresponds better to the behaviour of the actual motor vehicle than in the hitherto known electronic training apparatus. A further advantage of the training apparatus according to the invention resides in that the energy required for its operation is reduced to a minimum. The use of the capacitor for the simulation of the inertia of the engine results in the complete illusion of the running of the engine during instruction on the training apparatus.

The construction described by way of example constitutes a training apparatus for instructing road motor vehicle drivers. It will be apparent from the description and from the following claims that the arrangement according to the invention may also be employed in training apparatus for instructing drivers of other motor vehicles, for example of tractors running on endless tracks, cranes and the like, without departing from the essence of the invention. It is also possible without departing from the scope of the invention to employ a different number of simulated gear stages, a brake simulator and a number of other alternatives which may be added to the training apparatus constructed as described by way of example.

WHAT WE CLAIM IS:—

1. Training apparatus for instructing vehicle drivers, provided with an electric system for simulating the action of various component parts of the vehicle, comprising a first electric circuit for the simulation of the engine and a second electric circuit for the simulation of the gear box, the second circuit including resistors and at least one capacitor for the simulation of the inertia of the vehicle, an output of the second circuit being connected to the input of a third circuit for controlling a vehicle movement indicator, an acoustic transducer for the simulation of the engine noise being connected to an output of the first electric circuit, and the second circuit including selectable voltage limiters connected in parallel, one input of the second circuit including selectable charging branches and its output to a first trigger circuit including selectable feed branches connected in parallel.

2. Training apparatus according to Claim 1 including a variable voltage divider connected to the first and second circuit.

3. Training apparatus according to Claim 2 wherein the variable voltage divider is a variable resistor.

4. Training apparatus according to any one electric circuit, the input of the first trigger circuit which serves for discharging the capacitor or capacitors is connected to the second electric circuit, the input of the first trigger circuit being provided with a system of stepped resistors each of which is provided with a switch coupled to a control lever of the apparatus.

5. Training apparatus according to any one of Claims 1 to 3 wherein there is connected to the second electric circuit a second trigger circuit an input of which is connected to a series resistor which is connected to the electric circuit of the capacitor.

6. Training apparatus according to any one of Claims 1 to 3 wherein the or at least one of the capacitors is connected to the first electric circuit.

7. Training apparatus according to any one of Claims 1 to 3 wherein a fourth electric circuit for simulating the noise of the running vehicle is connected to an output of the second electric circuit.

8. Training apparatus according to Claim 7 wherein the fourth electric circuit is connected to an acoustic transducer via a mixing amplifier which is also connected between the

said acoustic transducer and an output of the first electric circuit.

9. Training apparatus according to any one of Claims 1 to 8 wherein the voltage limiters are formed by Zener diodes.

10. Training apparatus for instructing vehicle drivers substantially as herein described with reference to and as illustrated in the accompanying drawings.

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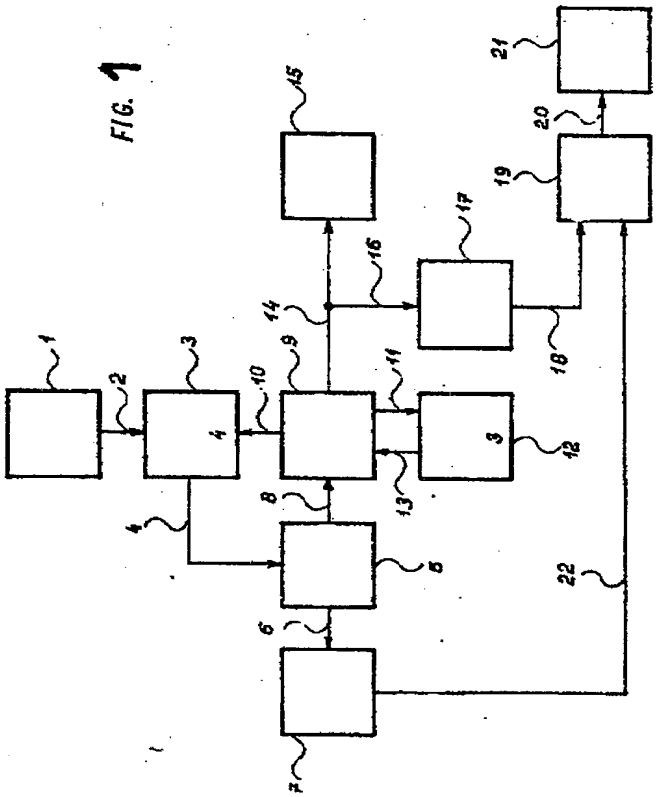
Sheet 1

FIG. 1



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Sheet 2

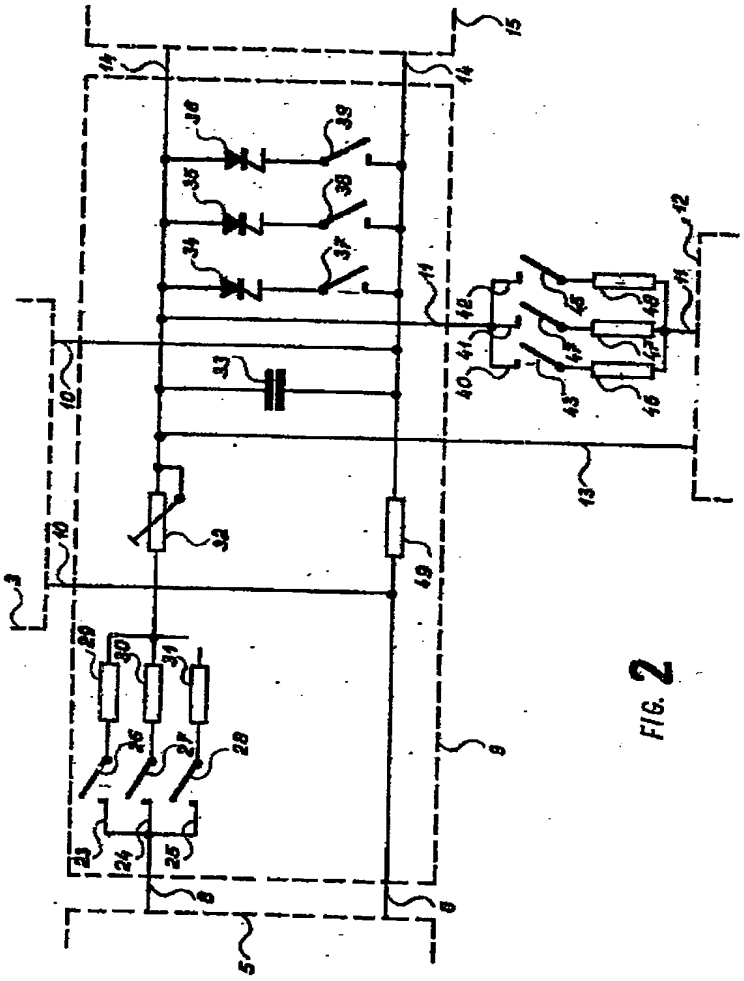

FIG. 2